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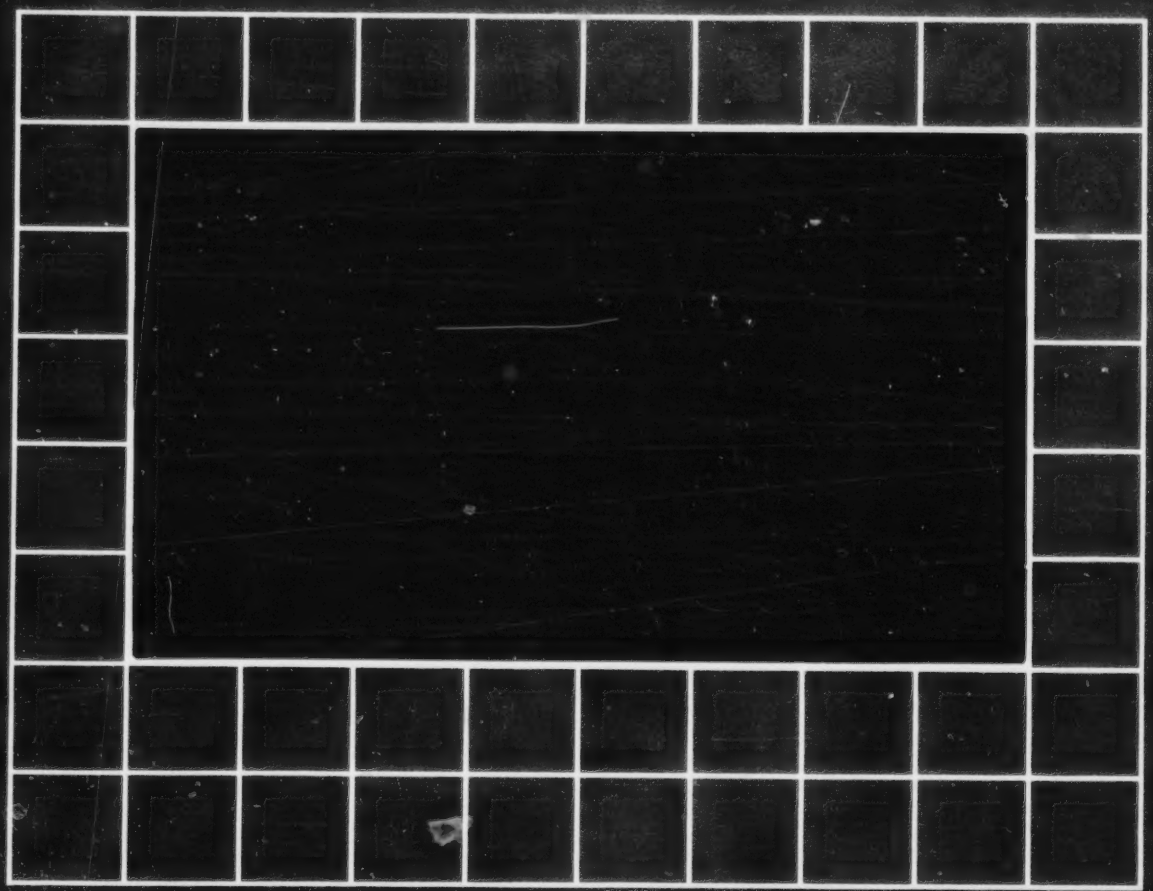
COPS - Consultant Report



Canada

DALCOR

CANADIAN OCCUPATIONAL PROJECTION SYSTEM

CONSTRUCTION SECTOR MODEL

FINAL REPORT

A DESCRIPTION OF THE METHODOLOGY AND RESULTS
for the development of
OCCUPATIONAL DEMAND COEFFICIENTS
and
CONSTRUCTION EMPLOYMENT PROJECTIONS
and
A SUMMARY OF THE SUPPLY DATA GATHERING PROCEDURES

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Glossary of Terms

Terminology in labour market analysis must be used precisely to avoid confusion. This glossary provides a brief outline of a number of terms used throughout this report.

CCDO - the Canadian Classification and Dictionary of Occupations which groups occupations into 23 major groups (2-digit), 81 minor groups (3-digit) and 498 unit groups (4-digit).

Census - a self reported comprehensive accounting of the population and its labour force activity. The most recent Census was taken on June 3, 1981 based on questionnaires. It reports the labour force as employed or unemployed by industry and occupation.

Construction Industry - comprised [only] of those firms whose primary business is construction. It does not include those firms who may carry out construction for themselves (own account) but whose primary business is not construction.

Construction Investment - all monies expended for contractors who perform new construction as well as those involved in repair and renovation. It also includes own account work done by owners to build or repair their own facilities.

Construction Occupations - those occupations which are involved directly or indirectly in Construction, whether employed by the Construction Industry or other industries.

Construction Trades - those occupations included in CCDO Occupational Group 87, being generally known as the Building Trades.

Employment - the average number of person years in a given occupation employed during the year as reported by the Labour Force Survey. This is essentially equivalent to the total number of hours worked in an occupation during the course of a year divided by approximately 1880, the number of hours which would be worked by a worker employed year round in a full-time job.

Informetrica - an econometric forecast consultant which generates projections of construction investment disaggregated by province and structure type.

Labour Force Survey (LFS) - based on a sample and provides estimates of the number of persons employed, unemployed and those not in the labour force. It is based on interviews. Employees are persons who for a wage did any work or those who had a job but were absent, but exclude those who are self-employed and persons providing services on a contract basis.

Machinery and Equipment - generally considered to be those facilities which are incorporated into a structure, but are removable without unduly affecting the integrity of the structure. For example, heating, ventilation and air conditioning equipment is not classed as machinery and equipment. Kitchen facilities, display cases and office equipment on the other hand are.

R. S. Means Incorporated - a US firm which produces statistics for use by the Construction Industry.

Occupational Demand Coefficients - sometimes called "technical coefficients", represent the number of hours of work required to complete $1 million (1981) of construction.

Persons Employed - the number of individual workers who work in the occupation during the course of a given year. This is equivalent to the number of hours worked in an occupation over the year divided by the actual average number of hours worked per person in the occupation.

SOC - essentially a subset of the CCDO designed for use by the Census.

1.0 SUMMARY

Construction unions and contractors, consultants and governments, owners and investors are all keenly interested in labour supply and demand information. These data assist in planning and scheduling construction projects. When the available labour supply is known and the future requirements for workers are better understood, then all parties involved are better able to meet their objectives.

Generally owners and contractors rely on labour information obtained through surveys, local pooling of data among various special interest groups and supplemental data available from national statistics. Labour gathers project information through discussion and the media. Governments depend on submissions from sponsors or their own commissioned studies.

There are obvious benefits from an improved data base which all those involved in construction would use if developed. The Canadian Occupational Projection System has a primary goal to develop such an improved data base for all occupations and industries.

DALCOR Innoventures was retained in 1984 to assist Canada Employment and Immigration with the Construction Sector Model. In particular, DALCOR was to develop construction demand coefficients which could be used as the basis for predicting employment resulting from projected construction expenditures over the next decade. In addition, we were to gather data from the Building Trades as the basis for evaluating the response of the labour market to various market demand conditions.

This document sets out the methodology and results of this work. It is the final product required under the contract, but work is intended to continue on the Construction Sector Model. (Figure 1)

The occupational demand coefficients described in this document incorporate our best estimates of technology and methods which will be employed over the next ten years. The coefficients are the basis for projections of future demands under various investment scenarios. The coefficients have been reconciled to the actual employment according to the 1981 Census, adjusted to the Labour Force Survey.

Stock and Flow data were gathered from the building trades for several of the construction trades occupations. These data form the basis for evaluating labour market response to potential demand scenarios. A preliminary model has been developed to evaluate response under various specified constraints.

The entire package has been laid into a computer data base to provide for ease of data maintenance and simplify on-going evaluation of new scenarios. This database will be available on a dial up basis to any potential user in Canada.

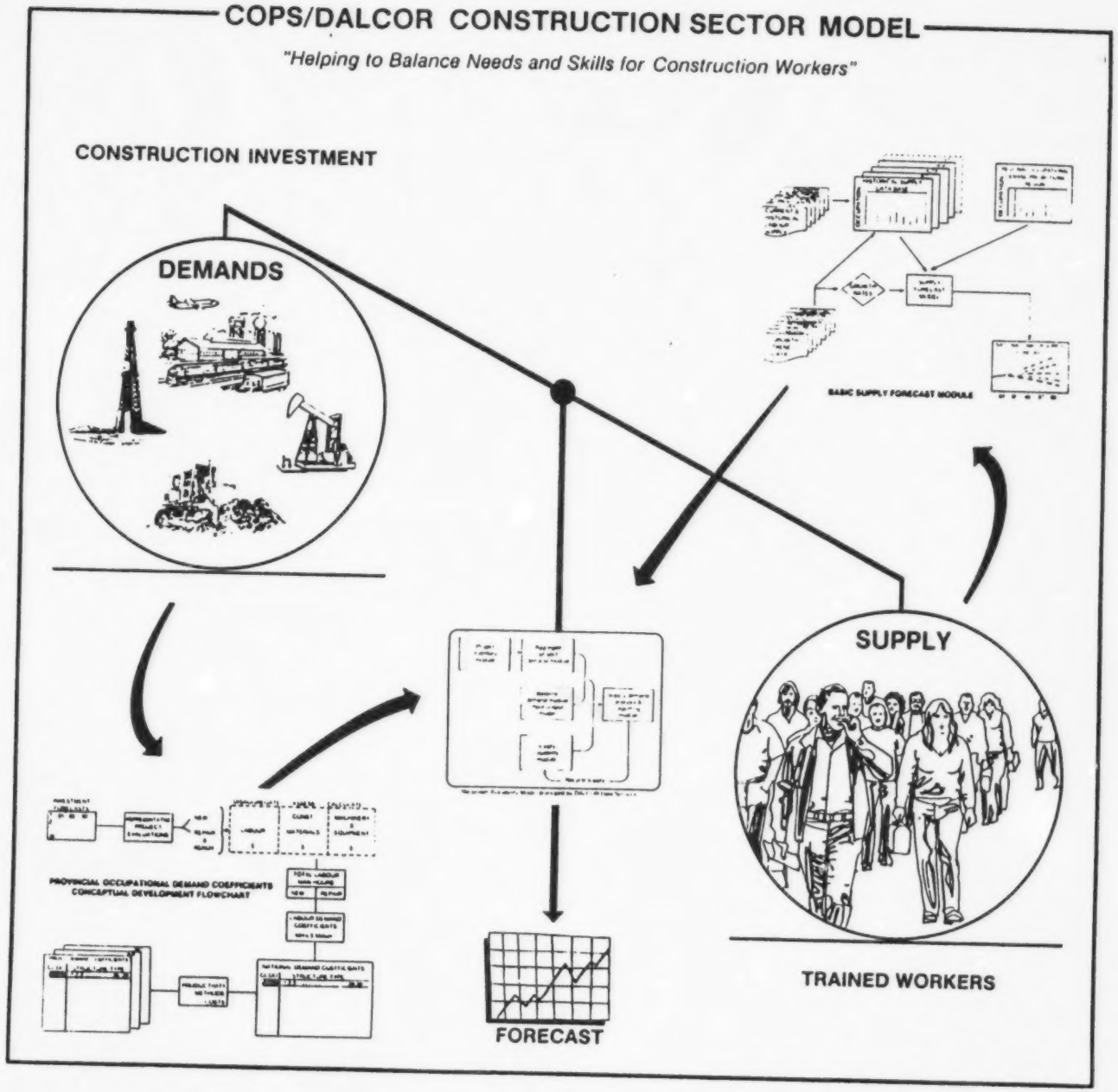
COPS/DALCOR CONSTRUCTION SECTOR MODEL
"Helping to Balance Needs and Skills for Construction Workers"
CONSTRUCTION INVESTMENT
DEMANDS
SUPPLY
TRAINED WORKERS
FORECAST
PROVINCIAL OCCUPATIONAL DEMAND COEFFICIENTS
CONCEPTUAL DEVELOPMENT FLOWCHART

FIGURE 1

2.0 INTRODUCTION

The Canadian Occupational Projection System (COPS) is under development by Canada Employment and Immigration. It is intended to provide a better understanding of the Canadian Labour Market. COPS is using a consultative process to draw on the best data and opinions available within both the public and private sector. As well as consultation, the unique nature of the work leads to the development of sector models for some of the more significant areas of the labour market.

The Construction Sector is recognized as one of the larger traditional employers in Canada, but also presents one of the most volatile labour markets. The Construction Sector Model has been developed to improve the understanding of construction and its labour market impacts.

Labour market assessment requires both an understanding of the nature of demands and a realistic assessment of supply. In a long term stable world, supply will inevitably tend to a steady state level where demands are matched by a labour supply which is utilized at the optimum number of hours of work per year considering the environment and the nature of the work itself. Typical macro-econometric projections suggest just such a situation, but the real world of construction is not so docile. It is strongly affected by the timing of large projects which can result in massive localized swings in demands.

COPS commissioned Informetrica to enhance their macro-econometric model by disaggregating construction spending projections into provincial detail with 29 structure types for each province. This disaggregation is generally in accordance with Statistics Canada's "Construction In Canada" (64-201). In order to effectively use the improved investment forecasts, occupational demand coefficients for each province and structure type had to be developed. DALCOR was retained to carry out this work.

In order to identify labour market imbalances, estimates of occupational stocks must also be developed. Evaluating the stock and flow of construction labour requires information on labour force stock, utilization, attrition and mobility.

DALCOR was retained to act as the agent of the Department to gather stock and flow data from the Building Trades.

This report is the final deliverable required under the terms of the contract. It describes the methodolgy and results of the work, outlines the COPS/DALCOR Construction Sector Model, and provides comments regarding the robustness of the data and procedures for on-going data maintenance. This report is expected to be the basic overview document for users of the "COPS/DALCOR Construction Sector Model".

Scope of Work -----

The original scope of work involved the following work elements:

- o DEMAND COMPONENT

  Coefficients for each of the 29 structure types for each province were to be developed based on the expected type of construction and technology to be employed during the period from 1983 to 1992. The coefficients, in terms of manhours per millions of 1981 dollars, were to cover the major occupations employed in construction at a 4 digit CCDO level. The coefficients were to be reconciled to the 1981 Census using actual 1981 investment.

- o SUPPLY COMPONENT

  Basic supply data for nine construction trades was to be assembled from those organizations which agreed to cooperate. The initial work was to focus on the Maritimes and subsequently to include the other provinces on a somewhat less rigorous basis, except in the case of the piping trades where an agreement had been struck with the UA and MCAC for a comprehensive study.

- o DELIVERY

  The results of the study were to be presented to COPS in a report form, in both French and English, with the supply data to be available in an electronic medium.

The demand component remains essentially as originally specified. However, DALCOR did independently develop a software capability for manipulating the data. This capability has been made available to the COPS group for demonstration purposes, but is not a part of the contracted deliverables. However, as part of the overall process, a major effort was expended to demonstrate the model to the Building Trades participants and to contractors' organizations.

On the supply side, the work varied to a greater extent from that originally intended. Data gathering was expected to be carried out at the national office level for the most part. In fact, a substantial part of the work actually involved working at the union "local" level. This resulted in increased time to carry out the work, especially in terms of follow-up.

The opportunity to participate in the project was ultimately extended to all of the building trades. This increased the overall volume of work. The project now incorporates the following building trades and is virtually nation wide:

- o United Association
- o IBEW
- o Labourers
- o Plasterers and Cement Masons
- o Ironworkers
- o Operating Engineers
- o Sheet Metal Workers
- o Insulators
- o Carpenters

A number of other groups participated to a greater or lesser extent in the process by way of discussion, provision of preliminary data or assistance with protocol. These groups include the Boilermakers, Painters, Bricklayers, Energy and Chemical Workers, Canadian Federation of Labour and the Executive Board.

In addition, the Province of British Columbia Ministry of Labour provided a useful input to the process in terms of methodology and data, and the Office du Construction of Quebec contributed data to the project.

3.0 PROVINCIAL CONSTRUCTION OCCUPATIONAL DEMAND COEFFICIENTS

The Canadian Occupational Projection System (COPS) is a massive data base combining macro-economic approaches with sector models for labour market analysis covering nearly 500 occupations at the 4-digit CCDO level. It uses macro-economic spending projections and employment coefficients to estimate future employment demands. DALCOR was retained in early 1984 to develop the occupational demand coefficients for the Construction Sector.

Historically, most macro-economic forecasts of construction employment used demand coefficients based on the generic industry as a whole. This approach ignores the very real differences in employment demands for a structure such as a refinery as opposed to a single family home. So long as the balance remains relatively constant, this is of little consequence. However, as the mix of construction changes and the technology of constuction methods evolves, a generic approach masks the impacts of change.

For example, generating plant construction investment grew from 5 percent of spending in 1981 to 8 percent in 1983. Commercial buildings fell from 12 percent to 10 percent over the same period. The COPS construction sector model attempts to come to grips with this problem by breaking construction investment forecasts into 29 structure types and then analysing the expected labour content for each to produce provincial occupational employment demand coefficients.

One of the major considerations in the Construction Sector Model and the work to develop demand coefficients is the definition of employment, construction investment and construction industry. These form the basis for the entire analysis and so must be treated with care. See the Glossary for an outline of key terms.

3.1 Methodology

The methodology to develop occupational demand coefficients is shown on Figure 2. More detailed information on the development of coefficients for each structure type is included in APPENDIX II to this report. A brief summary of the process follows below.

DALCOR has employed a "bottom-up" approach, building from 29 structure types to estimated employment demand coefficients. The structure types are shown on Table 3.1. The coefficients estimate the number of manhours required for a specific occupation, for a $ 1 million investment, in 1981 dollars, for each structure type, in each province in Canada. Using provincial investment forecasts of investment by structure type generated by Informetrica, the coefficients form the basis for estimates of employment by occupation resulting from these investments.

FIGURE 2

PROVINCIAL OCCUPATIONAL DEMAND COEFFICIENTS
DEVELOPMENT METHODOLOGY

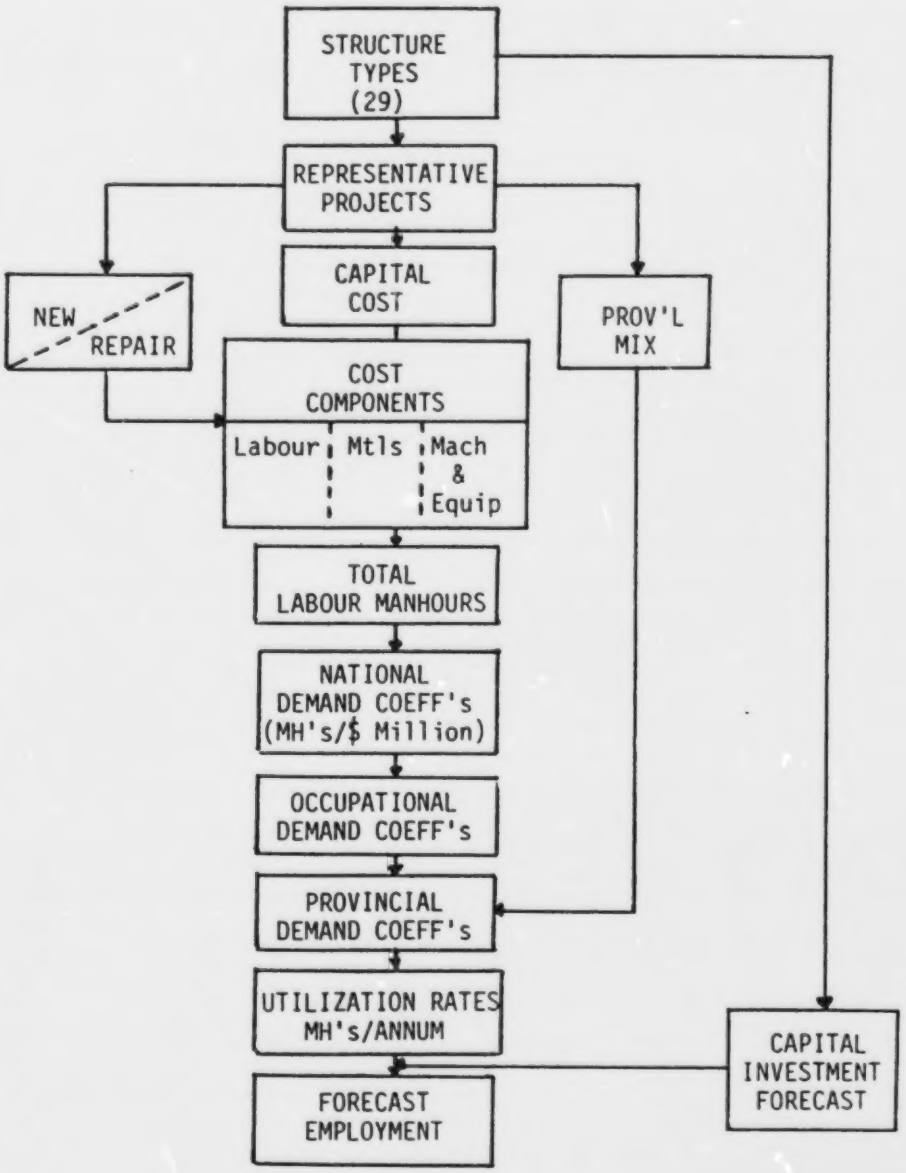

TABLE 3.1

STRUCTURE TYPES FOR CONSTRUCTION SECTOR MODEL

BUILDING PROJECTS

- Residential
- Factories
- Mine Buildings
- Other Industries
- Warehouses
- Office Buildings
- Other Commercial Buildings
- Schools
- Hospitals
- Farm Buildings
- Communications
- Other Buildings NES

ENGINEERING PROJECTS

- Marine
- Roads and Runways
- Sewage
- Waterworks
- Other Water
- Dams
- Generating Plants
- Other Power
- Railway
- Telephone and Communications
- Oil and Gas Wells
- Refineries
- Gas Plants
- Pipelines
- Mine Shafts
- Bridges
- Other Engineering

Each structure type is characterized by a representative project within each region. For many of the structures, the typical project is the same in all regions (i.e. waterworks). In others, the project will vary (i.e. electric power generation). Each typical project is then analyzed in detail to determine the total manhours associated with construction investment.

For most of the structure types, coefficients were developed on a national basis and converted to provincial estimates based on expected productivity variations between regions. Residential construction, generating plant and oil and gas wells were developed on a provincial basis from the outset due to the wide variation in the design of these facilities from province to province and the associated construction techniques used. It should be noted as well that these three structure types alone accounted for 44 percent of the value of construction work purchased in Canada in 1981. The relative importance of these activities on total capital spending is shown on Table 3.2

TABLE 3.2

VALUE OF CONSTRUCTION WORK PURCHASED CANADA 1981
($ millions)

	New	Repair	Total	% of Total
Total Construction	47,859	9,025	56,884	100
Total Building	25,851	5,686	31,537	55
Residential	13,135	3,229	16,365	29
Commercial	6,145	841	6,986	12
Total Engineering	22,008	3,339	25,347	45
Generating Plant	2,813	99	2,912	5
Oil and Gas Wells	5,171	413	5,583	10
Roads and Runways	3,255	836	4,092	7

Source: Statistics Canada Cat. No. 64-201 Construction in Canada

The total manhours are broken down into specific major occupations. Then, the estimated manhours for each occupation are converted to demand coefficients by dividing by the project investment (for labour and direct materials) in 1981 dollars to yield manhours per million 1981 dollars (MH's/$ Million).

An extensive data gathering process was employed to gather information from knowledgeable cost estimators working within each of the areas to be evaluated. Labour content by occupation and capital cost data were assembled to develop demand coefficients for each structure type. At the same time, information on trends in construction procedures, methods and technology were obtained.

Discussions were held with contractors, engineers and owners to obtain the data required to develop demand coefficients. Previous work done by DALCOR provided the basis for most of the engineering structure types. This work was updated to reflect anticipated future construction trends. Finally, information from governments, their agencies and from trade and other associations were incorporated where available and soundly based.

The concept is simple, but its use requires a good deal of care. Factors which are considered in the development of the coefficients are described in the following paragraphs.

- Construction varies throughout the country. Both labour productivity (in terms of value of work completed per manhour) and construction practise itself will be different in one region as opposed to another.

  For example, assuming equal physical output, lower wage rates in Atlantic Canada increase the manhours required to produce the same value of construction. This leads to differences in total construction costs and the labour cost component. Similarly, a tendency to build walk-up multiple residential dwellings in Quebec results in a somewhat different mix of skills than the single detached residential homes dominant in the West.

Coefficients estimated on a national basis were converted to represent provincial practise using the productivity factors shown on Table 3.3. Factors actually used for each province are marked with an asterisk. Note that a factor of less than 1.00 reduces the number of hours required to complete $ 1 million of construction, thereby implying either higher wage rates and a relatively more costly end product or increased output. Typically, it is a combination of both.

TABLE 3.3

PROVINCIAL PRODUCTIVITY FACTORS

Province	Productivity Factor
Yukon	1.21
Northwest Territories	1.31
British Columbia	0.96 *
Lower Mainland	0.96
Vancouver Isl	1.04
Interior	1.05
Northern BC	1.00
Alberta	1.00 *
Saskatchewan	1.11 *
Manitoba	1.10 *
Ontario	0.89 *
Southern Ontario	0.89
Northwestern Ont.	1.18
Quebec	1.03 *
Atlantic	1.22 *

Source: PCL Construction
* Factor used to develop coefficients.

- Investment, as defined in "Construction in Canada", is used to convert the coefficients into employment. This series includes ALL construction performed in Canada, whether installed by contractors or in the form of 'own account' work. Both must be included in the coefficients. Comparison to the Labour Force Survey is misleading because the Labour Force Survey reports employment only in the Construction Industry (i.e. contractors and related businesses). Similarly, LFS employment in construction occupations includes workers in other industries performing maintenance and other non-construction duties.

Construction in Canada and the Informetrica forecasts include Interest During Construction which for long duration projects may be a significant part of the total cost if highly debt financed. In estimating coefficents, the interest component must be removed from the expenditure forecasts. An assumed interest rate of 15 percent (the level in effect during the 1981 - 1983 period) has been used with specific assumptions regarding the proportion of debt and construction duration for each structure type. All debt has been assumed to be incurred at the mid-point of project construction. These are shown on Table 3.4.

TABLE 3.4
INTEREST DURING CONSTRUCTION EVALUATION

Structure Type	Est % Financed	Duration	IDC
Residential	incorporated into factors initially		
Factories	75	2.0 yr	11.25 %
Mine Buildings	75	2.0	11.25
Warehouses	75	0.5	5.6
Offices/Hotels	75	2.0	11.25
Marine	100	2.0	15.00
Roads, Hwys, Runways	50	0.25	1.00
Sewage Syst, Waterworks	50	1.0	4.00
Other Water/Sewer	50	0.5	2.00
Dams, Irrigation	use same as hydro dams		8.00
Generating Plant	specified by utility		8.00
Power Other	50	1.0	4.00
Railway	75	2.0	11.25
Tel & Comm	assume no financing applies		
O & G Wells (frontier)	20	3.0	4.50
Refineries	100	3.0	22.50
Gas Plants	100	2.0	15.00
Pipelines	75	1.0	5.63
Mine Shafts	75	3.0	16.88
Bridges	50	0.75	2.80

Source: Dalcor Estimates based on 15 % interest rate

- "Construction in Canada" does not include the removable machinery and equipment costs or the construction labour to install these components, yet the labour must be included in the coefficients. Offshore production platforms, mining draglines and process plant come under the machinery and equipment heading. Thus the work involves assessing the nature of machinery and equipment requirements for each structure type.

  Total construction costs (including machinery and equipment and installation) are included in Statistics Canada Catalogue No. 61-205 "Private and Public Investment in Canada", but are disaggregated by industry sector and province instead of structure type. In addition, they also include non-construction investments such as an office buying a new computer.

The evaluation of Machinery and Equipment is very critical. Assumptions are based on 1981 TO 1983 relationships. Those for 1981 are shown on Table 3.5. We found it impossible to separate construction related Machinery and Equipment from the non-construction component. This is probably not significant, except for a few of the building types such as hotels, warehouses and perhaps stores and institutional buildings. The total impact on our estimated employment is not large. The net effect is to make the model overly sensitive to investments in these categories.

TABLE 3.5

	MACHINERY AND EQUIPMENT COMPONENT OF CONSTRUCTION (AVG. 1981/83) (Percent)				SHARE OF TOTAL CONSTRUCTION (Percent)	
	NEW CONSTRUCTION		REPAIR CONSTRUCTION		TOTAL CONST	
	Const	M & E	Const	M & E	New	Repair
FACTORIES	24	76	17	83	76	24
MINE BLDGS.	66	34	12	88	80	20
WAREHOUSES	64	36	36	64	85	15
HOTELS	68	32	59	41	84	16
OFFICES	92	8	75	25	89	11
STORES	31	69	42	58	89	11
GARAGE/SVC STAT	32	68	47	53	66	34
THEATRES	92	8	75	25	91	9
SCHOOLS	77	23	81	19	79	21
CHURCHES	94	6	91	9	81	19
HOSPITALS	75	25	62	38	87	13
OTHER INST	86	14	71	29	88	12
FARMS	100	0	100	0		
MARINE	70	30	70	30	75	25
ROADS/HWYS	100	0	100	0	78	22
SEWAGE SYSTEMS	92	8	92	8	94	6
WATER PUMPING	71	29	71	29	93	7
OTHER WATER	100	0	100	0	88	12
DAMS & IRRIGAT	90	10	90	10	87	13
GENERATING PLT	60	40	41	59	97	3
POWER OTHER	60	40	41	59	88	12
RAIL TRACK/BED	65	35	37	63	64	36
TEL & COMM	32	68	18	82	77	23
OIL & GAS WELL	91	9			92	8
OIL REFINERIES	74	26	73	27	73	27
GAS PLANTS	74	26	73	27	74	26
PIPELINES	90	10	70	30	89	11
MINE SHAFTS	66	34	12	88	98	2
BRIDGES	100	0	100	0	81	19

Source: Dalcor Evaluation of Statistics Canada Cat No. 61-205

- Coefficients are for the 1984 to 1991 period. Some change is inevitable from the situation as it existed in 1981 due to changing methods and productivity. Coefficients reconciled to 1981 may not accurately reflect future trends.

Technological change is a prime consideration in future demands for workers. Prefabrication is one of the more significant shifts, but so too are evolutions such as shifts from metal to plastic pipe, automatic welding systems, energy efficient building construction, curtain wall construction and automatic track laying equipment. Incorporating such factors is one of the most subjective aspects of the work, yet the implications on trade mix and availability of employment are extreme. Wherever possible, a discussion of technological change is incorporated within each structure outline (presented in Appendix 2).

- 1981 investment as reported in "Construction in Canada" may be misleading in certain categories as a result of Statistics Canada's concerns to maintain confidentiality. For example, the $ 1.8 billion Foothills Pipeline pre-build is hidden in Other Engineering rather than Pipelines. Both categories are thus distorted.

Informetrica advises us that for their investment projections, they incorporate projects into the actual structure type in which they should fall, and thus avoid the type of problem posed by Foothills.

3.2 Results

The Construction Industry is only one source of employment for construction occupations. There is also significant employment in other industries for "own account" construction (which is reported by Statistics Canada in "Other Industries") and a further large amount in "Services". Coefficients for the Construction Industry only can be derived from the ratio of employment in the Construction Industry to the employment in all construction related activities. These ratios are estimated on Table 3.6.

TABLE 3.6
DEMAND COEFFICIENT CONVERSION FACTORS
CONSTRUCTION INDUSTRY TO TOTAL CONSTRUCTION

OCCUPATION	FOREMEN	OWN ACCOUNT	OTHER	TOTAL
Const mgmt		1.26	1.03	1.3
Proj Services		1.26	1.03	1.3
Architects		1.26	13.1	16.43
Chem Engineers		1.26	8.58	10.81
Civil Engineers		1.26	1.6	2.01
Electrical Eng		1.26	8.15	10.27
Industrial Eng		1.26	1.18	1.49
Mechanical Eng		1.26	6.55	8.25
Surveyors		1.26	3.86	4.86
Draftsmen		1.26	6.29	7.93
Technicians		1.26	5.95	7.50
System Analysts		1.26	2.43	3.06
Other Prof/Tech		1.26	8.02	10.10
Camp Services	1.135	1.1	1.0	1.25
Labourers	1.135	1.1	1.4	1.75
Mining/Drilling	1.135	1.1	1.0	1.25
Boilermakers	1.135	1.1	1.0	1.25
Sheetmetal Workers	1.135	1.1	1.0	1.25
Welders	1.135	1.1	1.0	1.25
Inspectors	1.135	1.1	4.5	5.62
Equipment Ops	1.135	1.1	1.0	1.25
Carpenters	1.135	1.1	1.0	1.25
Millwrights/Ind M	1.135	1.1	1.0	1.25
Electricians	1.135	1.1	1.0	1.25
Brick/Stone Masons	1.135	1.1	1.0	1.25
Conc Fin/Plasterers	1.135	1.1	1.0	1.25
Painters	1.135	1.1	1.0	1.25
Insulators	1.135	1.1	1.0	1.25
Roofers	1.135	1.1	1.0	1.25
Plumbers/PF's	1.135	1.1	1.3	1.62
Ironworkers	1.135	1.1	1.0	1.25
Truckdrivers	1.135	1.1	1.15	1.43
Other Trades	1.135	1.1	1.0	1.25

"Foremen" are based on ratio of foremen to workers as determined from 1981 Census data.
"Own Account" is construction work performed by owners.
"Other" is to account for workers primarily in services or government inspection directly associated with construction.
"Total" is the product of the three conversion factors.

All coefficients are reported in terms of manhours per million 1981 dollars. They estimate the total employment resulting from investment as reported in Construction in Canada or as forecast by Informetrica. Employment is estimated from the start of detailed design through to project turnover to the owner. .

Coefficients have been determined for generic occupational groups and include foremen. Each occupational group may include a single occupation or as many as 50 (at the four digit CCDO level). Typically, the more highly skilled and/or specialized occupations such as engineers are incorporated in a single coefficient. Others such as "Labourers" and "Other Trades" comprise 49 and 50 occupations respectively. The Appendix sets out the basic relationship between the occupational families used to develop the coefficients and the CCDO occupations.

Table 3.7 shows a typical set of demand coefficients. Demand coefficients for specific CCDO occupations within a generic family may be developed based on ratios included in the Appendix.

Demand coefficients are used to project employment according to the procedure shown below:

$$\text{EMPLOYMENT}(i,j,k) = \frac{\text{PDC}(i,j,k) \times \text{INVESTMENT}(i,j)}{\text{UTILIZATION RATE}(j,k)}$$

Where:	Employment	=	Workers Employed
	PDC	=	Demand Coefficient (hrs/$ mill 1981)
	Investment	=	$ million 1981
	Utilization Rate	=	hours worked per person per year

And:	i	is	structure type
	j	is	province
	k	is	occupation (or occupational family)

24-Oct-84

PROVINCIAL PENAND COEFFICIENTS

Construction Sector

(Manhours/Millions of 1981 Dollars)

Region: British Columbia

OCCUPATION	1 -- Rsdnt Total	2 -- Fact- ories	3 -- Mines	4 -- Other Indus	5 -- Whsnd Grain	6 -- Offcs Hotel	7 -- Other Carcl	8 -- Schls	9 -- Hosps	10 -- Fares	11 -- Coun- cains	12 -- N.E.S	13 -- Marin Const	14 -- Roads Runwy	15 -- Sewse Systa	16 -- Water Works	17 -- Other Water	18 -- Dams& Irrig	19 -- Gener Plant	20 -- Other Power	21 -- Rail- way	22 -- Tele- phone	23 -- Oil Wells	24 -- Oil Rfnry	25 -- Gas Plant	26 -- Pipe- lines	27 -- Mine Shfts	28 -- Bridg	29 - N.E.S
CONSTRUCT. MANAGEMNT	442	1261	391	293	293	256	608	366	230	0	336	313	470	1342	24	329	23	445	1469	174	799	651	298	253	277	294	932	237	461
PROJ.SERV. PERSONNEL	353	922	317	73	73	63	151	91	58	0	84	151	282	140	48	193	49	445	736	68	121	255	49	84	92	204	170	139	161
TRANSPORT MANAGEMENT	76	211	66	73	73	63	151	91	58	0	84	67	56	96	19	78	20	148	344	0	50	0	0	84	92	108	36	56	58
PUR/ OFFS & MANAGMT	292	1015	260	73	73	63	151	91	58	0	84	133	328	96	29	115	30	148	344	52	72	196	0	308	338	175	139	84	150
GEOLOGISTS	0	0	202	0	0	0	0	0	0	0	0	67	37	0	0	0	0	80	100	0	0	0	0	0	0	0	108	0	19
BIOLOGISTS	0	55	304	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	14	15	26	163	0	28
CHEMICAL ENGINEERS	0	410	71	0	0	0	0	0	0	0	0	102	37	0	0	0	0	45	57	12	0	44	0	140	154	0	38	0	29
CIVIL ENGINEERS	4	593	506	157	157	109	262	157	138	0	144	257	338	144	326	7074	226	376	349	70	250	263	51	84	92	270	271	1493	445
ELECTRICAL ENGINEERS	2	843	268	17	17	55	131	79	127	0	72	113	140	0	11	238	6	80	337	52	0	196	0	140	154	111	143	0	116
INDUSTRIAL ENGINEERS	0	187	8	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	14	15	0	4	0	2
MECHANICAL ENGINEERS	2	1101	528	18	18	55	131	79	127	0	72	201	229	0	24	432	25	80	337	0	0	0	0	196	215	167	283	0	140
METALLURGICAL ENGRS.	0	82	14	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	28	31	56	8	0	8
MINING ENGINEERS	0	0	588	0	0	0	0	0	0	0	0	196	0	0	0	0	0	0	0	0	0	0	0	0	0	0	314	0	19
OTHER ENGINEERS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SURVEYORS	2	656	233	73	73	63	155	93	58	0	85	124	196	1093	0	0	0	204	256	348	1891	1301	301	57	62	194	125	0	399
DRAFTSMEN	10	2835	936	242	242	330	781	470	598	0	432	503	593	307	239	1121	248	661	953	52	532	196	108	896	983	241	501	807	576
ENGINEERING TECHS.	11	1371	381	240	240	329	782	471	599	0	432	317	471	1299	427	1507	424	385	483	70	2247	263	458	420	461	225	204	1085	676
SYSTEMS ANALYSTS	0	253	123	0	0	0	0	0	0	0	0	41	326	0	0	0	0	0	0	0	0	0	0	84	92	122	66	0	43
ARCHITECTS	157	0	0	290	290	439	1043	628	806	0	576	243	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WELDING INSPECTORS	0	325	159	0	0	0	0	0	0	0	0	53	27	0	0	0	0	0	39	0	0	0	0	124	136	208	78	0	49
ELECTRICAL INSPECTORS	0	312	76	0	0	0	0	0	0	0	0	25	54	0	0	52	0	0	89	47	0	176	0	73	80	0	36	0	41
OTHER INSPECTORS	0	828	469	304	304	298	778	423	365	0	380	357	153	274	167	334	177	139	506	0	473	0	96	437	479	20	231	278	228
LABOURERS	3210	9296	2566	3289	3289	2543	9508	4388	2964	7579	4049	2798	1720	792	12653	7336	14847	2777	4065	6257	3157	23449	154	2212	2426	2007	1471	4495	5558
OPERATING ENGINEERS	152	3053	1477	238	238	130	618	173	114	2408	323	615	798	4538	7016	1751	9315	8391	2674	1397	5637	5237	1409	978	1073	1478	714	1287	3253
TRUCK DRIVERS	21	890	460	205	205	195	518	278	230	0	250	287	344	2809	101	218	4950	1388	2081	696	789	2610	500	233	255	893	175	178	1092
MINING/CUTTING OPERS	0	0	518	0	0	0	0	0	0	0	0	173	0	0	0	0	0	0	788	0	0	0	0	0	0	0	3816	0	239
CARPENTERS	5770	7258	2125	2726	2726	2201	6082	3743	2474	842	3076	2351	1568	0	4565	9869	0	0	1116	0	0	0	0	1874	2055	244	1047	5393	1840
MASONS/BRICKLAYERS	402	801	172	42	42	242	748	1197	675	0	331	152	46	0	24	24	0	0	17	0	0	0	0	82	89	0	82	0	34
CONCRETE FINISHERS	227	973	378	349	349	260	1279	369	245	2527	394	329	236	0	812	1748	0	0	567	0	0	0	0	387	424	11	188	1020	301
IRONWORKER	34	4783	1887	1683	1683	880	2604	684	626	13052	1592	1483	1198	0	507	1179	0	0	966	0	0	0	0	1322	1450	44	917	2054	640
SHIP / ENGINE FITTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAINTERS	709	956	334	60	60	142	230	155	150	0	215	179	45	0	0	5	0	0	80	0	0	0	0	286	314	9	164	0	72
INSULATORS	0	1628	634	286	286	272	584	389	322	0	348	397	0	0	0	0	0	0	17	0	0	0	0	913	1001	11	326	0	163
ROOFING WORKERS	1410	78	57	723	723	106	766	143	89	0	369	295	0	0	0	30	0	0	0	0	0	0	0	0	0	0	26	0	4
SHEET METAL WORKERS	186	1097	320	193	193	1080	2263	2085	1454	0	1223	531	322	0	0	56	0	0	89	0	0	0	0	431	472	4	164	0	108
INDUSTRIAL MECHANICS	0	2030	563	172	172	0	0	2	12	0	0	245	154	1187	0	1622	0	0	274	0	1128	0	264	277	303	23	1021	0	387
BOILERMAKERS	0	1526	585	0	0	0	0	0	0	0	0	195	0	0	0	0	0	0	177	0	0	0	0	945	1036	0	305	0	187
OTHER CONSTR. TRADES	1125	906	209	434	434	1463	1265	1293	840	0	700	702	1	0	0	15	0	0	1001	0	0	0	0	297	325	0	108	0	102
WELDERS	0	1671	1052	241	241	126	373	98	89	0	228	473	171	0	0	0	0	0	199	0	0	0	0	297	325	907	511	0	226
PIPEFITTRS / PLUMBRS	1346	9484	2266	931	931	1235	2757	1438	2185	0	1160	1477	74	0	0	91	0	0	390	0	0	0	0	3277	3595	168	1169	0	655
POWER LINESMEN	0	761	221	0	0	0	0	0	0	0	0	74	0	0	0	0	0	0	0	1355	0	5077	0	101	110	0	106	0	421
ELECTRICIANS	1537	6133	1391	2118	2118	2159	4956	2138	2903	0	2370	1889	524	0	24	330	0	0	1763	0	0	0	183	1346	1476	56	988	0	469
CAMP/CATERING PERS.	1346	1292	902	0	0	0	0	0	0	0	0	301	294	0	0	0	0	148	1453	0	0	0	0	743	815	307	729	0	190

TABLE 3.7

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3.3 RECONCILIATION OF DEMAND COEFFICIENTS TO 1981 CENSUS and LABOUR FORCE SURVEY

The demand coefficients are reconciled to the May 31, 1981 Labour Force Survey estimate of employed workers. This corresponds closely to the date of the Census and June is believed to reflect the peak level of employment. Since the LFS only provides 2-digit detail, employment levels at the 4-digit level are derived by distributing LFS employment estimates using the proportions of workers as reported in the 1981 Census.

Figure 3 illustrates the basic reconciliation procedure. Reconciliation requires that figures, estimated using the Statistics Canada estimates of construction spending and the demand coefficients, be compared to the specific portion of the workforce that they represent.

The broad correlation is first checked against the 1981 Census data.

For purposes of reconciliation, employed workers in the Construction Industry total 726,625 according to the 1981 Census. This group includes the Construction Trades, Non-construction Trades, Professional Staff, Typists, Clerks and Salespeople. Excluding clerical and sales personnel, this estimate is reduced to 663,900.

According to the Census, workers employed in other industries, but involved with construction, total 332,807. These are construction trades in other industries and professional personnel.

The total employment from the 1981 Census (excluding clerical and sales) in 1981 was 996,707. This compares directly to the total demand projected using 1981 estimates of investment and the demand coefficient is 994,699. If the procedure described in the Appendix is used to adjust the Census data to conform to the Labour Force Survey, then, the employment in 1981 would be reduced to 967,624, and the apparent error in the coefficients is slightly larger (about 3% as opposed to 0%). Either way, the comparison at a national level is extremely close without adjustments to the coefficients.

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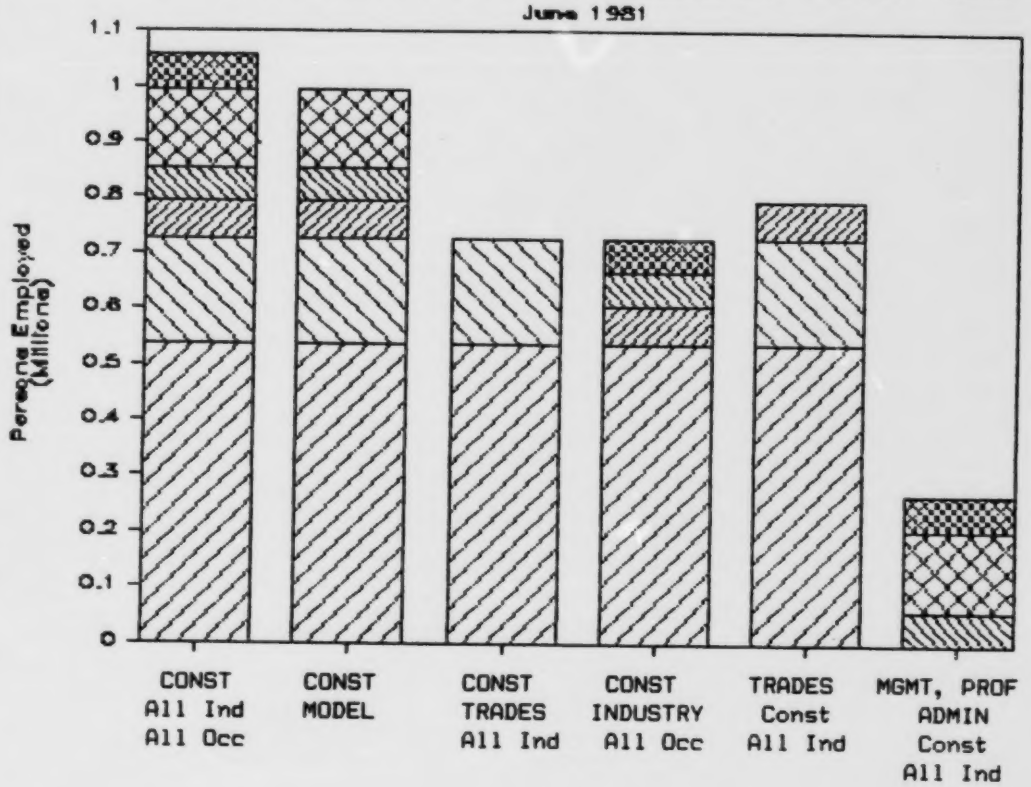
RECONCILIATION to CENSUS and LFS



"Construction Trades" occupations in the Construction Industry (Division 6) 537,150 people (50.7%).

"Construction Trades" occupations in other industries, 187,712 people (17.7%).

"Non Construction Trades" in the construction industry (Division 6) 67,515 people (6.4%) (eg. truck drivers, boilermakers).

"Professional Staff" in the construction industry (Division 6) 59,235 people (5.6%).

Other "Professional Construction Staff" (Divisions 1-5 & 7-11) 145,095 people (13.7%) (eg. consulting engineers).

"Typists, Clerks and Salespersons" in the construction industry (Division 6) 62,725 people (5.9%).

Figure 3

Employment in services to the construction industry, especially in consulting engineering and architectural firms, is greatly influenced by construction volume. The coefficients we have developed incorporate employment related to construction in these firms as well. Certainly, feasibility studies, preliminary and detailed design, project supervision and inspection for construction projects creates significant employment directly related to construction investment. However, at the present time, there is no data which can be used to reconcile these coefficients at an occupation specific basis.

On the other hand, a more rigorous approach could be followed for the Construction Trades occupations. In fact, all estimates were compared to the Census figures on an occupation by occupation basis. Although the 2-digit level correlation is reasonable, at the provincial or 4-digit occupation level, correlation is less precise. In some cases, the variation is quite significant. This is to be expected for a number of reasons including:

- o imprecision in occupational coding
- o difficulty in estimating precisely the occupations which will be involved in a "generalized" structure type
- o the fact that DALCOR's coefficients reflect the future in construction (1984-1991) as opposed to the situation in 1981
- o utilization rate of workers has a great impact on estimated numbers of workers involved to complete a specified volume of work
- o the province of employment is not always the same as the province of residence for Census purposes.

Census data are prone to upgrading by respondents. This means that owner operator tradesmen for example, will report as management rather than as tradesmen. Thus, there is a tendency for the labour force survey and the census to report relatively higher numbers of management and relatively lower numbers of tradesmen.

Among the management and professional occupations, the specific industry served is not clear. Our procedure uses estimates of employment in those occupations in the construction industry as reported by the 1981 Census. For some occupations, this approach is viable, but in others, it is clearly misleading. For example, only about 1.5 percent of the architects report themselves in construction. One would reasonably expect a majority at least, and perhaps two thirds or more, should depend on construction for their livelihood. As well, 7 percent of the civil engineers identify with the construction industry, but this figure excludes those working for consulting firms who are closely associated with construction. Thus, we find that our estimates of employment for these occupations tend to be higher than those indicated by the Census for Construction.

Among the trades, the average number of hours worked per year has a major impact on the number of workers who are actually involved in construction. The actual hours are masked by the fact that union and non-union workers may be one and the same. Thus, we find that our initial reconciliation is very good in Quebec where we have excellent data covering all workers. In other provinces, the data are based on estimates and the results show a somewhat wider variation. Among the managerial and professional occupations, employment tends to be full time and so variations in hours of work are much less.

The location of the work may not be the same as that of the project itself, especially among the professional and managerial occupations. This means that these occupations can only be reconciled at the national level. In other words, estimates of employment in regions with large concentrations of engineers and project management contractors tend to be lower than the numbers of workers resident there. This occurs because these workers may be working on projects located in other regions of the country or in other countries altogether. Larger firms tell us that some 10 percent of their professional workers are working on foreign assignments.

In spite of these factors, the coefficients represent a reasonable basis for estimating future construction employment much more accurately and consistently than historic approaches which consolidated total construction employment into a single static relationship at an aggregated level.

3.4 Employment Demand Projections

The source for all historical data regarding construction investment is the Construction Division, Industry Statistics Branch, Statistics Canada (Catalogue 64 - 201). Forecast data from Informetrica are provided by Employment and Immigration.

Employment projections may be made for each occupation by structure type or by province. The projections are based on econometric data which by their nature tend to be free of major anomolies. Typical output is shown on Table 3.8.

3.5 Updating Requirements

The coefficients have been determined based on the best data available to us. However, circumstances change. Construction techniques are continuously evolving and so the coefficients will not remain valid. DALCOR has considered this problem and recommends that updating occur regularly.

Investment projections change routinely. Informetrica prepares a new econometric forecast every three months or so. The most current projection should be used as the basis for employment projections. The demand coefficients themselves have a longer life. As they are forward looking, they already incorporate some of the expected shifts in construction methods and labour productivity. However, DALCOR feels that they should be reassessed on a five year cycle. This will generally be adequate to reflect the pace of change in the industry. A few structure types are dominated by major projects. Technology for these tend to change in a single quantum step rahter than over a longer evolutionary process. Where such a change occurs, the coefficients become invalid immediately and should be updated. A good example is the decision to use fixed concrete production facilities rather than floating structures for Hibernia development.

TABLE 3.8

RUN DATE: 24-Oct-85

CONSTRUCTION SECTOR EMPLOYMENT FORECAST

(in Manyears)

Region: BRITISH COLUMBIA Structure: CONSTRUCTION INVESTMENT - GRAND TOTAL

OCCUPATION	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	AVERAGE
CONSTRUCT. MANAGEMNT	1681	1559	1590	1632	1692	1761	1827	1900	1945	2082	1767
PROJ.SERV. PERSONNEL	766	716	739	756	773	812	852	887	909	930	814
TRANSPORT MANAGEMENT	245	231	236	248	255	273	291	306	316	333	274
PUR/ OFFS & MANAGMT	593	550	593	610	625	661	681	707	726	738	648
GEOLOGISTS	58	55	50	42	44	48	53	52	52	49	50
BIOLOGISTS	79	75	74	62	65	69	72	70	69	64	70
CHEMICAL ENGINEERS	35	31	50	55	61	69	69	72	77	77	60
CIVIL ENGINEERS	514	490	536	552	582	611	622	645	664	683	590
ELECTRICAL ENGINEERS	220	209	241	255	272	300	320	338	356	364	288
INDUSTRIAL ENGINEERS	9	8	16	19	22	24	24	26	28	29	21
MECHANICAL ENGINEERS	284	270	312	318	339	370	386	403	421	422	353
METALLURGICAL ENGRS.	13	14	19	19	19	20	20	20	21	21	19
MINING ENGINEERS	113	105	100	74	79	81	81	73	68	53	83
OTHER ENGINEERS	0	0	0	0	0	0	0	0	0	0	0
SURVEYORS	812	759	834	873	923	934	920	952	973	1080	906
DRAFTSMEN	1007	941	1083	1165	1249	1347	1389	1451	1512	1564	1271
ENGINEERING TECHS.	1281	1195	1327	1433	1523	1540	1537	1590	1629	1759	1483
SYSTEMS ANALYSTS	67	65	79	78	77	82	79	81	84	82	77
ARCHITECTS	452	406	442	496	524	550	565	592	609	623	526
WELDING INSPECTORS	79	80	96	93	95	103	102	104	108	107	97
ELECTRICAL INSPECTOR	59	55	67	71	77	86	93	98	104	107	82
OTHER INSPECTORS	603	556	614	670	719	767	791	821	849	889	728
LABOURERS	11615	10793	11814	12514	13161	13966	14556	15287	15804	16282	13579
OPERATING ENGINEERS	4769	4527	4866	5146	5437	5616	5681	5920	6073	6578	5461
TRUCK DRIVERS	2005	1896	1960	2082	2182	2283	2402	2535	2620	2946	2291
MINING/CUTTING OPERS	745	698	606	436	469	503	536	542	542	499	558
CARPENTERS	9371	8547	9051	9410	9646	10014	10174	10484	10656	10646	9800
MASONS/BRICKLAYERS	732	664	715	761	794	826	840	875	895	898	800
CONCRETE FINISHERS	867	799	866	939	992	1058	1099	1146	1181	1202	1015
IRONWORKER	1961	1762	2036	2225	2397	2581	2648	2724	2826	2862	2402
SHIP / ENGINE FITTER	0	0	0	0	0	0	0	0	0	0	0
PAINTERS	953	870	911	922	936	969	981	1007	1017	1003	957
INSULATORS	397	354	448	488	537	593	601	616	644	646	532
ROOFING WORKERS	1718	1550	1565	1581	1578	1606	1625	1650	1650	1628	1615
SHEET METAL WORKERS	975	888	1013	1148	1232	1314	1352	1429	1483	1518	1235
INDUSTRIAL MECHANICS	837	765	854	866	931	954	937	961	986	1077	917
BOILERMAKERS	233	215	275	285	316	361	369	376	394	390	322
OTHER CONSTR. TRADES	1975	1813	1876	1988	2047	2148	2238	2335	2386	2415	2122
WELDERS	583	561	650	645	674	709	706	717	736	724	670
PIPEFITTRS / PLUMBRS	3204	2905	3398	3623	3843	4117	4179	4329	4479	4488	3854
POWER LINESMEN	440	399	470	466	507	565	632	679	718	758	564
ELECTRICIANS	3991	3616	3985	4303	4529	4801	4964	5163	5325	5395	4607
CAMP/CATERING PERS.	1995	1856	1842	1815	1821	1907	1988	2042	2062	2044	1937
TOTAL	58335	53848	58301	61164	64643	67421	69283	72005	73996	76058	65445

4.0 CONSTRUCTION TRADES LABOUR SURVEY

4.1 Methodology

A major component of the Construction Sector Model is a database covering the stock and flow of workers in the industry. At this time, work was limited to the Building Trades. Data for other occupational groups will be obtained later.

Data was obtained for Quebec and British Columbia through the auspices of the Office du Construction and Ministry of Labour respectively. In all other provinces, the labour unions themselves were the primary data source. Apprenticeship data come from provincial records, but are supplemented by the labour unions. The Long File, available through CEIC, is also a source of data on geographic and occupational mobility.

The basic approach was to meet senior representatives of each trade at the national level to gain support for the project. At the same time, the type of data which might be obtained was identified. Questionnaires were developed from this first interview and were then reviewed with the national representative. From this point, two distinct paths evolved. Some of the trades coordinated the distribution of questionnaires through the national office. Others felt that the work should be done at the local level. In the latter case, DALCOR served as the agent of the Department to meet with the local representatives and coordinate the data acquisition.

In total, more than 100 face to face meetings have occurred. Telephone follow-up and reminder letters were also used.

Appendix V sets out the procedure, questionnaire framework and form letters which were used. Dissemination of specific data elements will only occur with the prior approval of the contributing trade. Aggregate data and summary level projections will be available on the public database.

4.2 Future Updating

The results obtained to date indicate that a certain degree of personal contact does increase participation, response rate and level of detail provided.

Nine unions actively participated in the survey, some however on a local by local basis. All those involved were assured that the process would be continued annually. This is necessary because supply data do change quickly. An annual process should be established and maintained.

An annual inventory and updating is planned to maintain the most current view of labour stocks.

5.0 CONSTRUCTION SECTOR MODEL

5.1 Structure and Operation

DALCOR has established a computer database and a model to manipulate the data. It includes three major components:

- o a system to project macro-economic construction employment demands on a regional, occupational or structure type basis
- o a system to evaluate the labour demands for a single project
- o a system to evaluate the response of the labour force to various demand scenarios

A knowledgeable analyst realizes that problems develop from peaks and valleys in demands which occur as larger projects are built or as economic growth peaks with a number of coincident projects under construction. The system allows for analysis of short-term dislocations by increasing or reducing investment for a year or two and assessing the labour market impact. These dislocations may be concentrated into a region, structure type or occupation.

The model can be used to address the following types of issues:

- o Where and when are peaks or valleys in demand?
- o What is the maximum rate of change to meet peaks?
- o How does utilization rate change with shifts in demand/supply balance?
- o How does supply decay during periods of oversupply?
- o When is a tradesman lost to the industry?
- o What is the effect of productivity change?

Users will take advantage of the data to meet their own specific needs. The system has been developed to make such assessments as easy as possible. Users may "dial up" from anywhere in the country to access the capabilities. Model structures and typical outputs are shown on the following pages.

5.2 Investment Data

The base data in the system is supplied from the Informetrica econometric model of the Canadian economy. Users may choose to use their own projections. This requires that the data be consistent with that provided from Informetrica. That means, it must conform to the structure type disaggregation which has been employed by Informetrica (i.e. generally in line with Statistics Canada Catalogue 64-201, Construction in Canada.

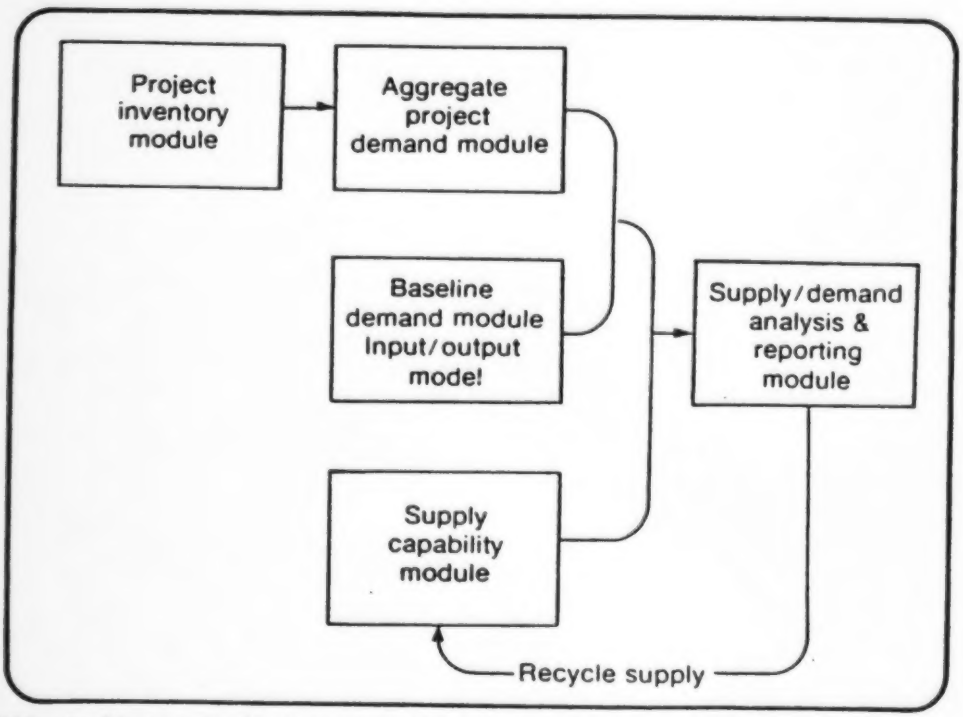


FIG. 4 Manpower Availability Model developed by DALCOR Data Services.

TABLE 5.1

08-Oct-85 02:50 PM DALCOR_DATA_SERVICES

DETAILED SUPPLY FORECAST - Workers

OCCUPATION: PIPEFITTRS / PLUMBRS REGION: ALBERTA

YR.	START STOCK	TRAIN (+)	RETIRE (-)	DTHACC (-)	RESIGN (-)	ABROAD (-)	EMIG (-)	BASIC STOCK	MOBILTY (+/-)	IMMIG. (+)	END STOCK
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
83	70	1	0	1	1	0	0	69	592	4	665
84	665	1	3	5	7	0	2	648	-10	0	637
85	637	0	3	5	6	0	2	620	-6	0	613
86	613	1	3	5	6	0	2	598	-4	0	593
87	593	1	3	5	6	0	2	578	-3	0	574
88	574	3	3	5	6	0	2	563	-1	0	561
89	561	1	3	4	6	0	2	546	-1	0	544
90	544	1	3	4	5	0	2	531	0	0	530
91	530	1	3	4	5	0	2	517	0	0	516
92	516	3	3	4	5	0	2	505	0	0	504
93	504	1	3	4	5	0	2	492	0	13	505
94	505	1	3	4	5	0	2	493	0	13	506
95	506	1	3	4	5	0	2	494	0	13	507
96	507	2	3	4	5	0	2	496	0	13	510
97	510	1	3	4	5	0	2	497	0	13	510
98	510	1	3	4	5	0	2	498	0	13	512
99	512	1	3	4	5	0	2	499	0	13	513
0	513	2	3	4	5	0	2	501	0	13	514

RESULTS REFERENCE FILE IS: PUB1:[DALDAT]F40123456.RFS;1

TABLE 5.2

08-Oct-85 02:12 PM

DALCOR_DATA_SERVICES

MANPOWER SUPPLY FORECAST - Workers

OCCUPATION: PIPEFITTRS / PLUMBRS

YR	BC	ALTA	SASK	MAN	ONT	QUR	NB	NS	PEI	NL	NWT	YUK	CDA
81	0	0	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0
83	714	70	1447	1459	4430	11519	1135	623	6056	5140	0	0	32593
84	719	169	1323	1352	4311	9820	1183	1040	6684	4721	0	0	31322
85	724	165	1318	1262	4014	9072	1194	1217	6850	4478	0	0	30294
86	732	162	1206	1174	3790	8468	1197	1168	7134	4248	0	0	29279
87	717	158	1288	1109	3599	7916	1198	1119	6886	4146	0	0	28136
88	722	154	1194	1035	3427	7453	1198	1073	7221	4003	0	0	27480
89	726	153	1190	968	3259	7019	1192	1210	7436	3904	0	0	27057
90	732	150	1091	905	3098	6613	1184	1154	7750	3799	0	0	26476
91	725	147	1163	857	2948	6233	1176	1099	7532	3763	0	0	25643
92	731	143	1077	802	2800	5877	1167	1046	7786	3677	0	0	25106
93	750	155	1077	758	2677	5514	1157	1191	7930	3600	0	0	24809
94	772	165	993	716	2562	5176	1148	1137	8161	3519	0	0	24349
95	784	175	1059	683	2454	4861	1138	1086	7976	3482	0	0	23698
96	805	184	986	646	2353	4567	1129	1037	8123	3412	0	0	23242
97	821	194	986	612	2259	4293	1120	1180	8193	3349	0	0	23007
98	842	204	911	579	2170	4038	1112	1127	8312	3275	0	0	22570
99	857	212	970	553	2088	3801	1105	1076	8126	3237	0	0	22025
0	876	221	903	525	2010	3579	1098	1028	8236	3173	0	0	21649

RESULTS REFERENCE FILE IS: PUB1:[DALDAT]F40123456.RES;1

TABLE 5.3

24-Oct-85 03:18 PM

Page: 1

ESOJECT.SUMMARY.REPORT

PROJECT I.D.: 2001 NAME: OIL P/L 575 KM 16 INCH ID
SPONSOR NAME: ESSO RESOURCES CANADA
PROBABILITY: 10 %
CONST. SCHED: 8608 TO 8810

CAPITAL COST (MILLIONS)
1981: 413.0 AS SPENT: 593.0

		PERSON YEARS											TOTAL HOURS
		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL	('000)
EXPENDITURE PROFILE (1981$)		0.00	0.00	0.00	0.00	20.7	161.	231.	0.00	0.00	0.00	412.7	
EMPLOYMENT DEMANDS (by OCCUP)													
01 1145	CONSTRUCT. MANAGEMNT	0.0	0.0	0.0	0.0	7.9	37.6	20.4	0.0	0.0	0.0	65.9	116
02 1175	PROJ.SERV. PERSONNEL	0.0	0.0	0.0	0.0	11.5	28.1	6.4	0.0	0.0	0.0	46.0	81
03 1147	TRANSPORT MANAGEMENT	0.0	0.0	0.0	0.0	4.1	14.9	3.4	0.0	0.0	0.0	24.4	43
04 1141	PUR/ OFFS & MANAGMNT	0.0	0.0	0.0	0.0	9.8	23.9	5.5	0.0	0.0	0.0	39.2	69
05 2112	GEOLOGISTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
06 2133	BIOLOGISTS	0.0	0.0	0.0	0.0	2.2	2.3	1.2	0.0	0.0	0.0	5.7	10
07 2142	CHEMICAL ENGINEERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
08 2143	CIVIL ENGINEERS	0.0	0.0	0.0	0.0	23.1	34.7	3.0	0.0	0.0	0.0	60.8	107
09 2144	ELECTRICAL ENGINEERS	0.0	0.0	0.0	0.0	9.5	14.3	1.3	0.0	0.0	0.0	25.0	44
10 2145	INDUSTRIAL ENGINEERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
11 2147	MECHANICAL ENGINEERS	0.0	0.0	0.0	0.0	14.3	21.4	1.9	0.0	0.0	0.0	37.5	66
12 2151	METALLURGICAL ENGRS.	0.0	0.0	0.0	0.0	4.8	7.1	0.6	0.0	0.0	0.0	12.5	22
13 2153	MINING ENGINEERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
14 2159	OTHER ENGINEERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
15 2161	SURVEYORS	0.0	0.0	0.0	0.0	10.9	26.7	6.1	0.0	0.0	0.0	43.8	77
16 2163	DRAFTSMEN	0.0	0.0	0.0	0.0	20.5	30.8	2.7	0.0	0.0	0.0	54.0	95
17 2165	ENGINEERING TECHS.	0.0	0.0	0.0	0.0	19.2	28.8	2.5	0.0	0.0	0.0	50.6	89
18 2183	SYSTEMS ANALYSTS	0.0	0.0	0.0	0.0	6.8	16.6	3.8	0.0	0.0	0.0	27.3	48
19 2141	ARCHITECTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
20 8336	WELDING INSPECTORS	0.0	0.0	0.0	0.0	2.4	20.8	24.1	0.0	0.0	0.0	47.2	83
21 8734	ELECTRICAL INSPECTOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
22 8796	OTHER INSPECTORS	0.0	0.0	0.0	0.0	0.1	1.6	2.8	0.0	0.0	0.0	4.5	8
23 8798	LABOURERS	0.0	0.0	0.0	0.0	13.6	162.8	275.9	0.0	0.0	0.0	452.3	796
24 8710	OPERATING ENGINEERS	0.0	0.0	0.0	0.0	13.3	139.8	179.8	0.0	0.0	0.0	333.0	586
25 9175	TRUCK DRIVERS	0.0	0.0	0.0	0.0	6.0	74.4	120.7	0.0	0.0	0.0	201.1	354
26 7710	MINING/CUTTING OPERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
27 8780	CARPENTERS	0.0	0.0	0.0	0.0	1.7	19.8	33.6	0.0	0.0	0.0	55.1	97
28 8782	MASONS/BRICKLAYERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
29 8783	CONCRETE FINISHERS	0.0	0.0	0.0	0.0	0.1	0.8	1.4	0.0	0.0	0.0	2.3	4
30 8793	IRONWORKER	0.0	0.0	0.0	0.0	0.3	3.5	5.9	0.0	0.0	0.0	9.7	17
31 8592	SHIP / ENGINE FITTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
32 8785	PAINTERS	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.0	0.0	1.7	3
33 8786	INSULATORS	0.0	0.0	0.0	0.0	0.0	0.9	1.4	0.0	0.0	0.0	2.3	4
34 8787	ROOFING WORKERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
35 8333	SHEET METAL WORKERS	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	1.1	2
36 8584	INDUSTRIAL MECHANICS	0.0	0.0	0.0	0.0	0.1	1.9	3.1	0.0	0.0	0.0	5.1	9
37 8337	BOILERMAKERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
38 8799	OTHER CONSTR. TRADES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
39 8335	WELDERS	0.0	0.0	0.0	0.0	10.2	90.0	104.3	0.0	0.0	0.0	204.5	360
40 8791	PIPEFITTRS / PLUMBRS	0.0	0.0	0.0	0.0	1.9	16.5	19.1	0.0	0.0	0.0	37.5	66
41 8730	POWER LINESMEN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
42 8733	ELECTRICIANS	0.0	0.0	0.0	0.0	0.3	4.8	7.5	0.0	0.0	0.0	12.5	22
43 6100	CAMP/CATERING PERS.	0.0	0.0	0.0	0.0	2.1	30.5	36.7	0.0	0.0	0.0	69.3	122
TOTAL	(All Occupations)	0.0	0.0	0.0	0.0	198.6	856.3	876.8	0.0	0.0	0.0	1931.8	3400

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TABLE 5.4

RUN DATE: 24-Oct-85

CONSTRUCTION SECTOR EMPLOYMENT FORECAST

(in Manyears)

Region: BRITISH COLUMBIA Structure: CONSTRUCTION INVESTMENT - GRAND TOTA

OCCUPATION	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	AVERAGE
CONSTRUCT. MANAGEMNT	1681	1559	1590	1632	1692	1761	1827	1900	1945	2002	1767
PROJ.SERV. PERSONNEL	766	716	739	756	773	812	852	887	909	930	814
TRANSPORT MANAGEMENT	245	231	236	248	255	273	291	306	316	333	274
PUB/ OFFS & MANAGMT	593	550	593	610	625	661	681	707	726	738	648
GEOLOGISTS	58	55	50	42	44	48	53	52	52	49	50
BIOLOGISTS	79	75	74	62	65	69	72	70	69	64	70
CHEMICAL ENGINEERS	35	31	50	55	61	69	69	72	77	77	60
CIVIL ENGINEERS	514	490	536	552	582	611	622	645	664	683	590
ELECTRICAL ENGINEERS	220	209	241	255	272	300	320	338	356	364	288
INDUSTRIAL ENGINEERS	9	8	16	19	22	24	24	26	28	29	21
MECHANICAL ENGINEERS	284	270	312	318	339	370	386	403	421	422	353
METALLURGICAL ENGRS.	13	14	19	19	19	20	20	20	21	21	19
MINING ENGINEERS	113	105	100	74	79	81	81	73	68	53	83
OTHER ENGINEERS	0	0	0	0	0	0	0	0	0	0	0
SURVEYORS	812	759	834	873	923	934	920	952	973	1000	906
DRAFTSMEN	1007	941	1083	1165	1249	1347	1389	1451	1512	1564	1271
ENGINEERING TECHS.	1281	1195	1327	1433	1523	1560	1537	1590	1629	1759	1483
SYSTEMS ANALYSTS	67	65	79	78	77	82	79	81	84	82	77
ARCHITECTS	452	406	442	496	524	550	565	592	609	623	526
WELDING INSPECTORS	79	80	96	93	95	103	102	104	108	107	97
ELECTRICAL INSPECTOR	59	55	67	71	77	86	93	98	104	107	82
OTHER INSPECTORS	603	556	614	670	719	767	791	821	849	889	728
LABOURERS	11615	10793	11814	12514	13161	13966	14556	15287	15804	16282	13579
OPERATING ENGINEERS	4769	4527	4866	5146	5437	5616	5681	5920	6073	6578	5461
TRUCK DRIVERS	2005	1896	1960	2082	2182	2283	2402	2535	2620	2946	2291
MINING/CUTTING OPERS	745	698	606	436	469	503	536	542	542	499	558
CARPENTERS	9371	8547	9051	9410	9646	10014	10174	10484	10656	10646	9800
MASONS/BRICKLAYERS	732	664	715	761	794	826	840	875	895	898	800
CONCRETE FINISHERS	867	799	866	939	992	1058	1099	1146	1181	1202	1015
IRONWORKER	1961	1762	2036	2225	2397	2581	2648	2724	2826	2862	2402
SHIP / ENGINE FITTER	0	0	0	0	0	0	0	0	0	0	0
PAINTERS	953	870	911	922	936	969	981	1007	1017	1003	957
INSULATORS	397	354	448	488	537	593	601	616	644	646	532
ROOFING WORKERS	1718	1550	1565	1581	1578	1606	1625	1650	1650	1628	1615
SHEET METAL WORKERS	975	888	1013	1148	1232	1314	1352	1429	1483	1518	1235
INDUSTRIAL MECHANICS	837	765	854	866	931	954	937	961	986	1077	917
BOILERMAKERS	233	215	275	285	316	361	369	376	394	390	322
OTHER CONSTR. TRADES	1975	1813	1876	1988	2047	2148	2238	2335	2386	2415	2122
WELDERS	583	561	650	645	674	709	706	717	736	724	670
PIPEFITTRS / PLUMBRS	3204	2905	3398	3623	3843	4117	4179	4329	4479	4488	3859
POWER LINESMEN	440	399	470	466	507	545	632	679	718	758	564
ELECTRICIANS	3991	3618	3985	4303	4529	4801	4984	5163	5325	5395	4607
CAMP/CATERING PERS.	1995	1856	1842	1815	1821	1907	1988	2042	2062	2044	1937
TOTAL	58335	53848	58301	61164	64043	67421	69283	72005	73996	76058	65445